

Bell Work
24-April-17

**Please compute the “ $-\log(7)$ ”
using your calculator?**

What are acids and bases?

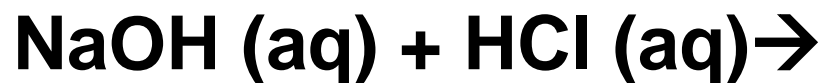
EQ: What bases have you used today and how did they help you?

Agenda:
introduction to Acid Base Chemistry

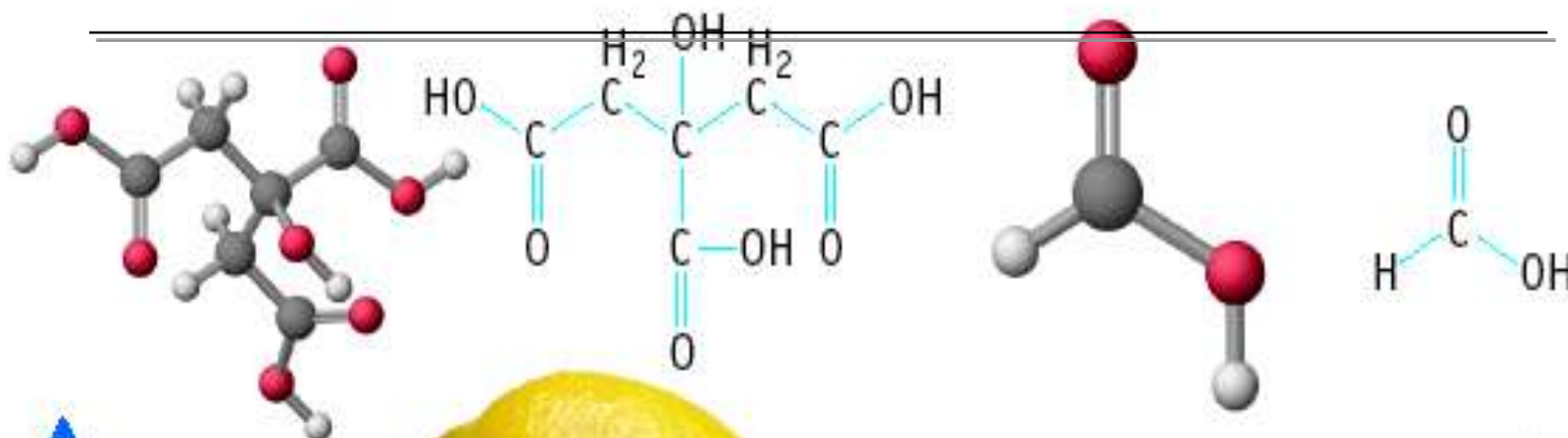
Objective:

Following the lesson you will be able to name simple acids and bases, know a general definition of an acid, and know how acids and bases taste

Visual Introduction to Acid Base Chemistry



Acid and Bases



▲ The tartness of lemons and oranges comes from the weak acid citric acid. The acid is found widely in nature and in many consumer products.
(Charles D. Winters)



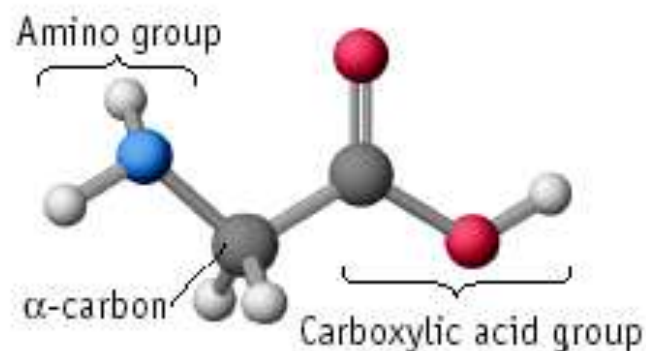
▲ The sting of ants is due to the weak acid formic acid, HCO_2H .
(Gallo Images/@ CORBIS)



Acid and Bases



▲ Aspirin is a weak acid that has been used as an analgesic for over 100 years.
(Charles D. Winters)

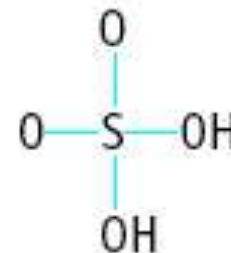


▲ Glycine is representative of the amino acids that are the basis of proteins. The $-\text{CO}_2\text{H}$ group is the acid portion of the molecule, and the $-\text{NH}_2$ group is the basic portion. (Charles D. Winters)

Acid and Bases



▲ Caffeine is a well known stimulant and a weak base. (Charles D. Winters)



▲ A sea slug excretes the strong acid sulfuric acid in self-defense. (Sharksong/ M. Kazmers/Dembinski Photo Associates)



Acids

Multiple definitions:

Lewis

Arrhenius

Bronsted Lowry

Generally it's a chemical compound that produces a hydrogen ion concentration higher than pure water:
 $[H^+]$ or $[H_3O^+]$



Acids



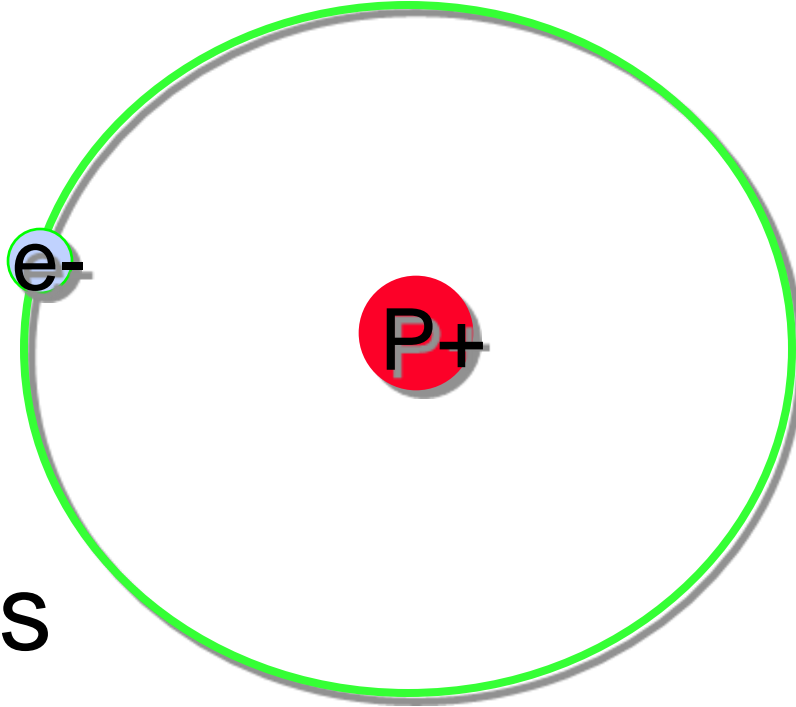
React with carbonates and bicarbonates to produce carbon dioxide gas

Have a sour taste. Vinegar is a solution of acetic acid. Citrus fruits contain citric acid.

Some Properties of Acids

Produce H^+ (as H_3O^+ ions in water):

Call a “proton”



Taste sour

Corrode metals

Acid Nomenclature Review

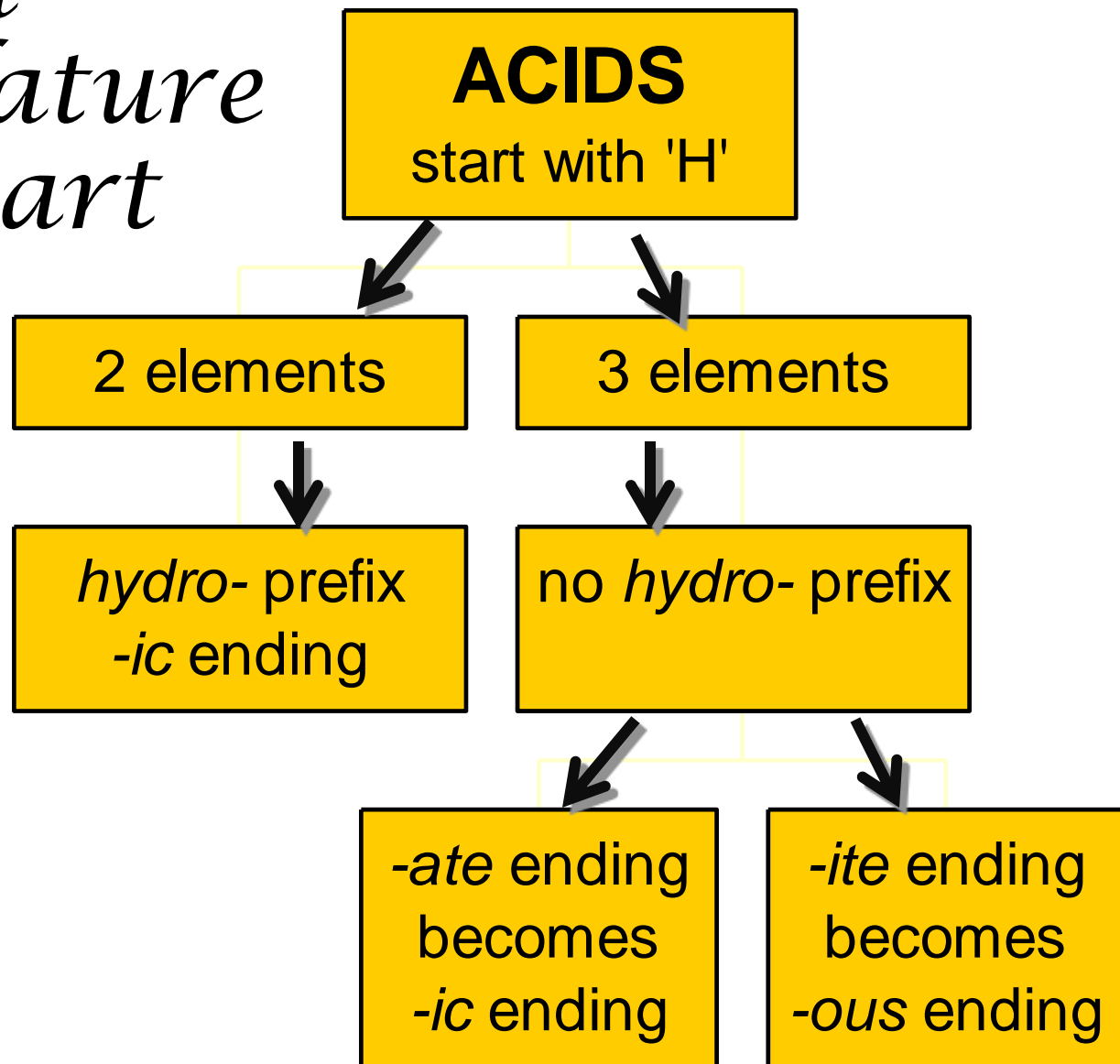
Anion Ending		Acid Name
Binary	→ -ide	hydro-(stem)-ic acid
Ternary	→ -ate	(stem)-ic acid
	→ -ite	(stem)-ous acid

Acid Nomenclature Review

*An easy way to remember which goes
with which...*

*“In the cafeteria, you ATE something
ICky”*

Acid Nomenclature Flowchart



Acid Nomenclature Review

$\text{HBr}_{(\text{aq})} \Rightarrow$ hydrobromic acid

$\text{H}_2\text{CO}_3 \Rightarrow$ carbonic acid

$\text{H}_2\text{SO}_3 \Rightarrow$ sulfurous acid

Strong Acids

Completely dissociates in water.

You will need to remember these three:



Name 'Em!

HF

HCl

H₂SO₄

HNO₃

HIO₃

Which are
strong acids?



Bases

A chemical species that donates hydroxide ions (OH^-) or that accepts protons.

Have a bitter taste.

Feel slippery. Many soaps contain bases.

Some Properties of Bases

Produce OH^- ions in water

Taste bitter, chalky

Are electrolytes

Feel soapy, slippery



Name these Common Bases



Drain cleaner



Liquid soap



Stabilizer for plastics



Milk of magnesia



Maalox (antacid)

Naming Bases

Group I metals all form strong bases with hydroxide

Same name as chemical name

Ex. NaOH – Sodium hydroxide

List the rest of them (write their names and chemical formulas)

KNOW THEM

Recall...

In your own words define:

What an acid and base are,

How can you distinguish them,

How do you name them

Bell Work

25.April.2017

Name the following acids and bases:

CsOH

HBr

HNO₂

Write the correct formula for the following acid and bases

Ammonia

Acetic Acid

Carbonic Acid

Hydroiodic Acid

EQ: What bases have you used today and how did they help you?

Agenda:

Understanding the pH scale PHet Simulation

Objective:

Following the lesson you will be able to name identify what the pH scale is, the relative difference in values on the scale and where common house hold solution register.

Home Work

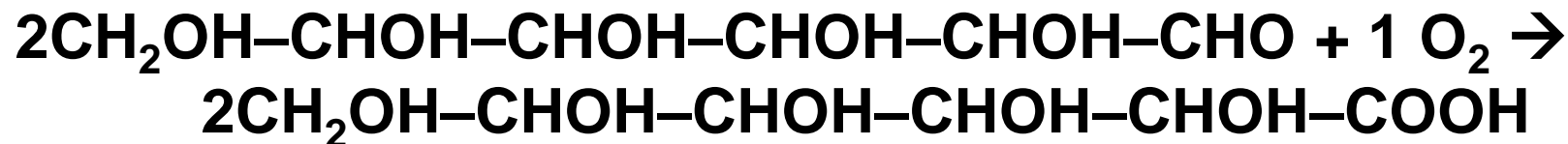
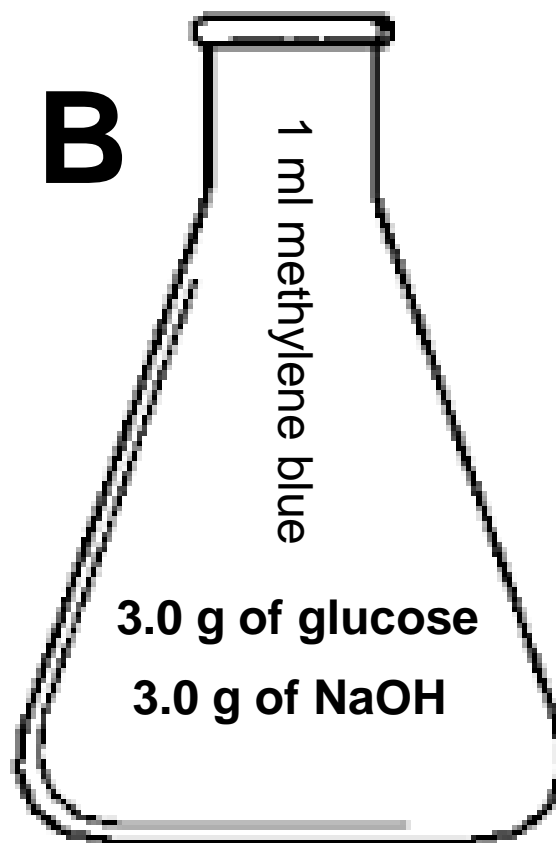
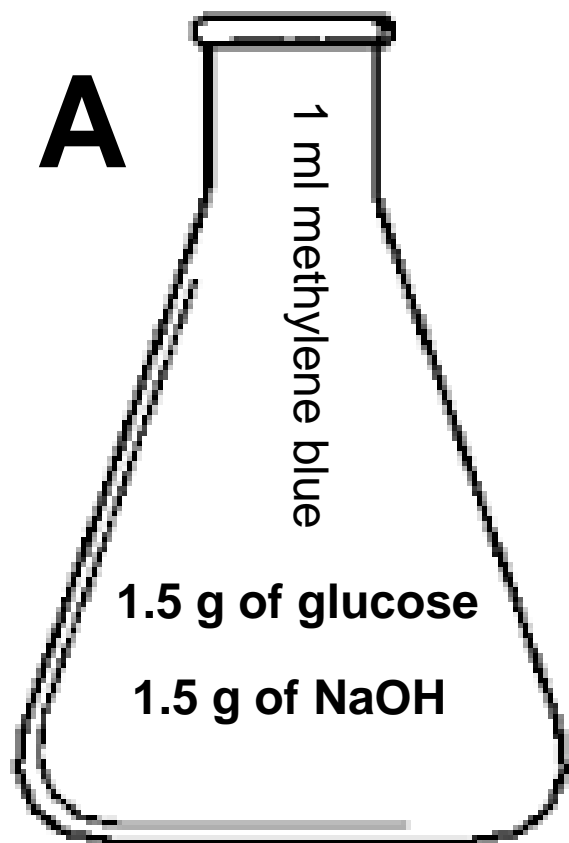
Be able to label acids, bases, conjugate bases, and conjugate acids in a balance acid base reaction. You may use you text book to accomplish this.

Introduction to pH

**PhET Simulation on class website under labs
“Under Standing pH”**

Due 1May2017

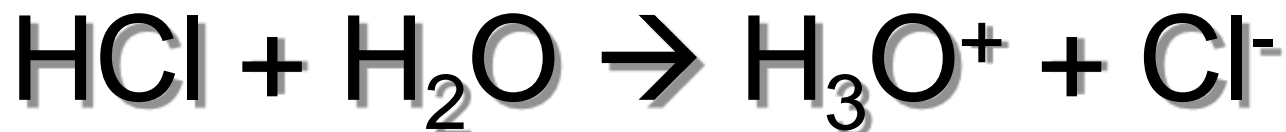
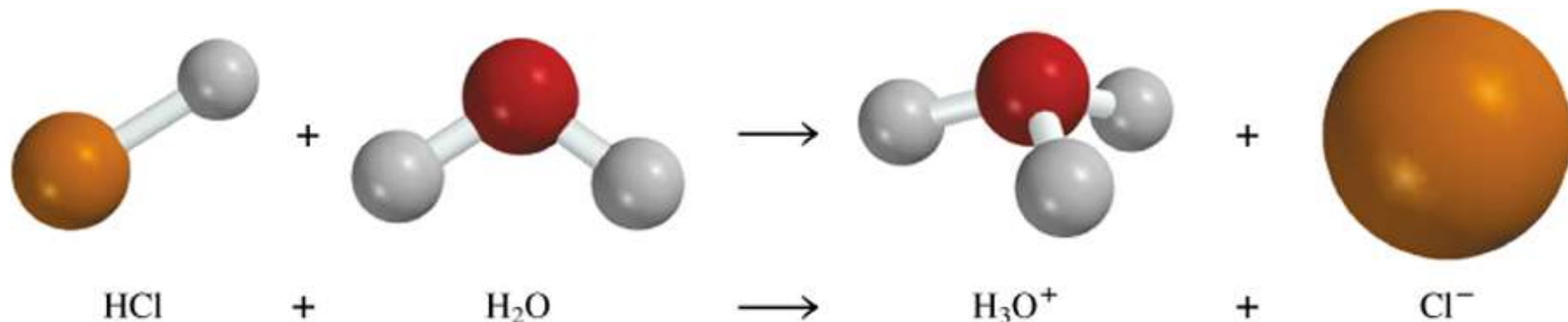
Color Change Oxidation



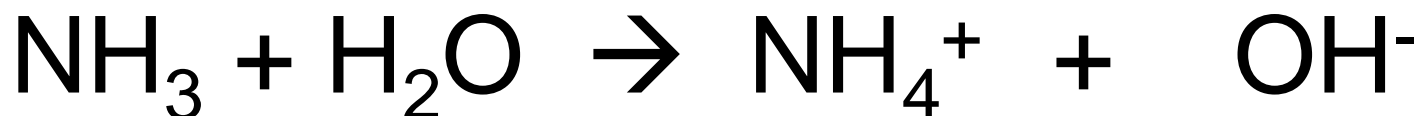
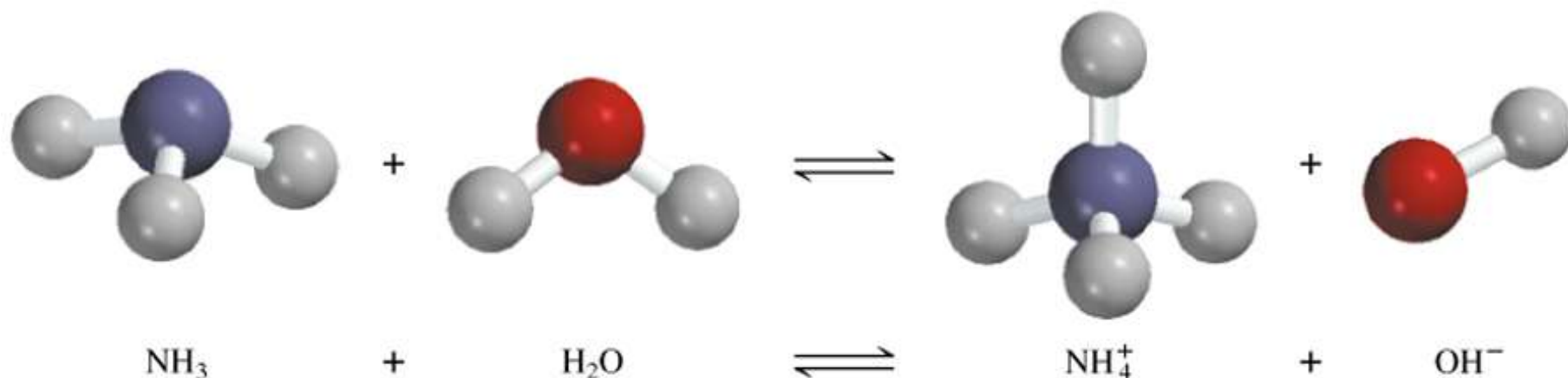
Visual Introduction to Acid Base Chemistry

Complete one more section B, C, or D today

Arrhenius acid: “is a substance that produces H^+ (H_3O^+) in water”



Arrhenius base: “is a substance that produces OH⁻ in water”



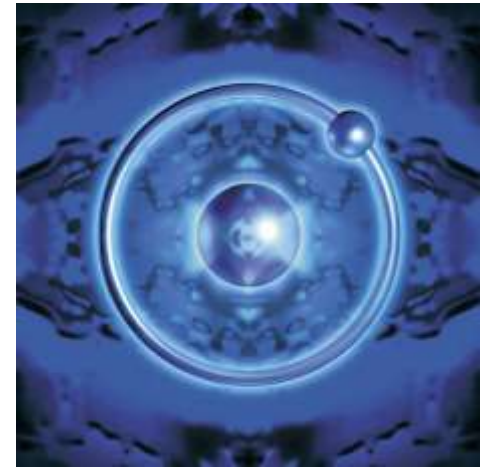
Acid/Base Definitions

Definition #2 Brønsted – Lowry

Acids – proton donor

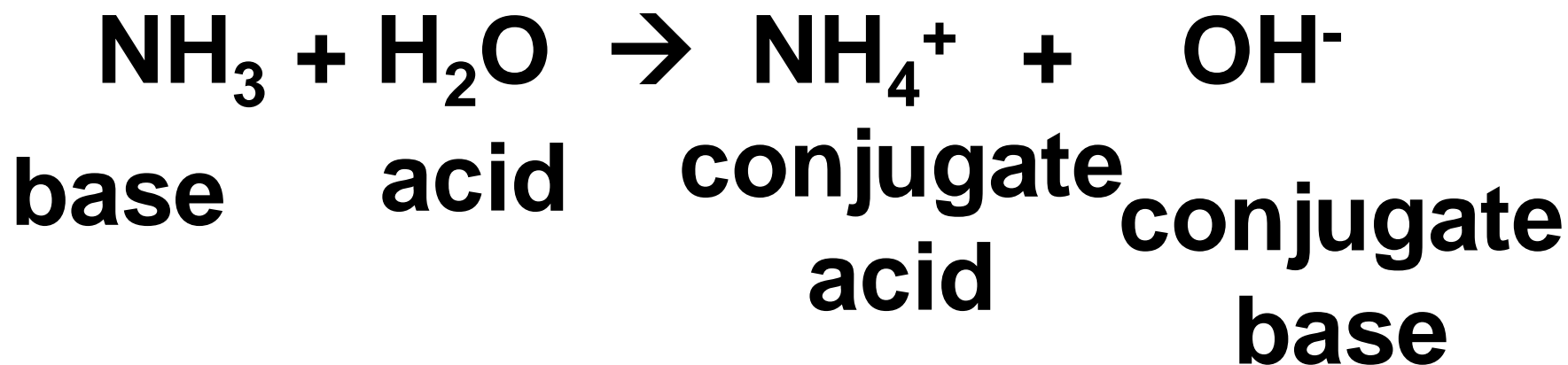
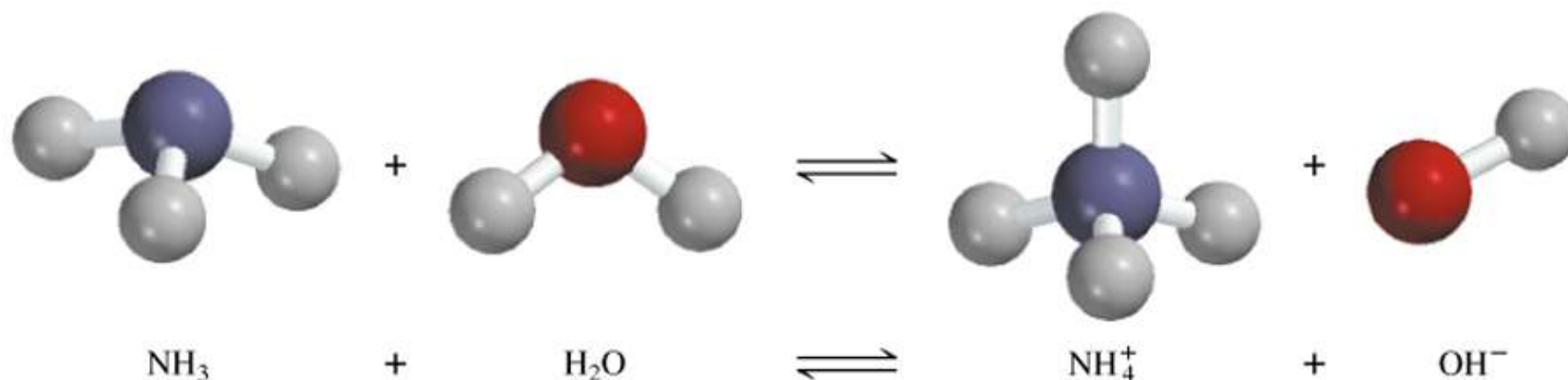
Bases – proton acceptor

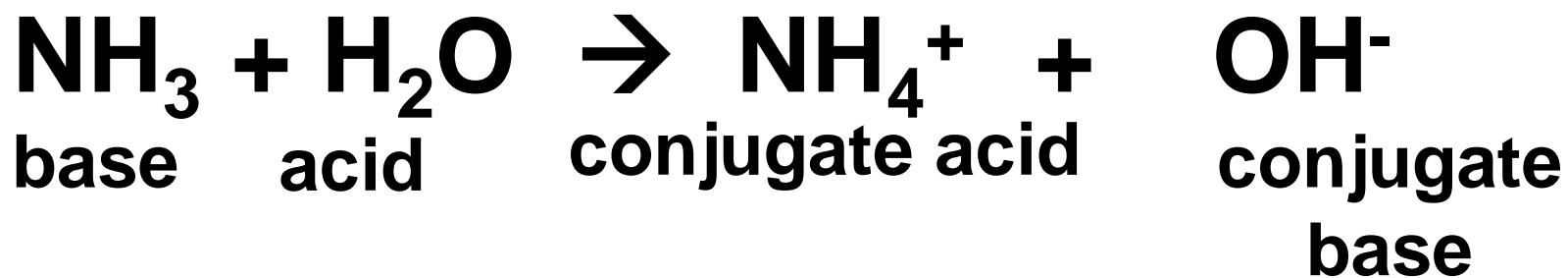
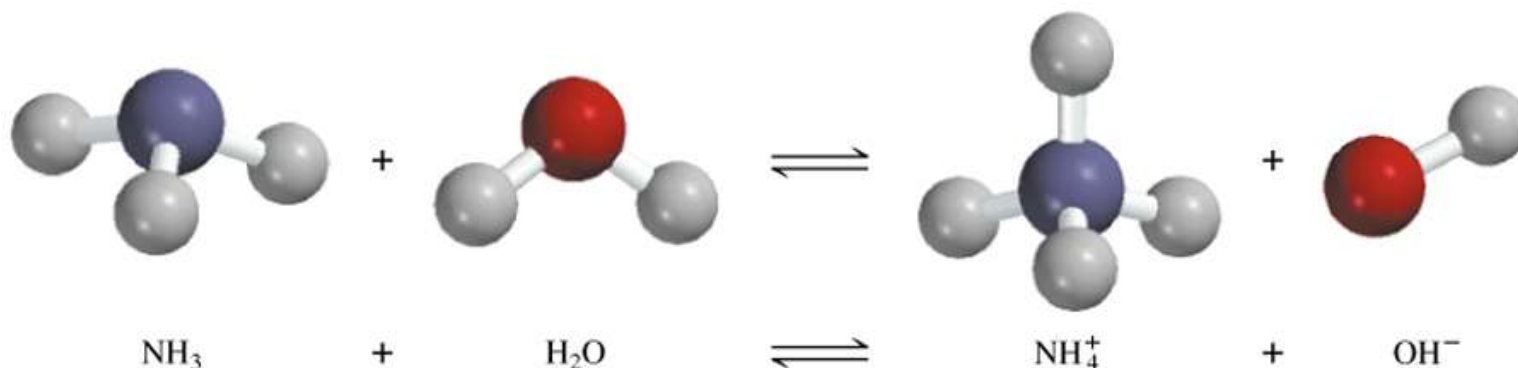
A “proton” is really just a hydrogen atom that has lost its e^- !



A Brønsted-Lowry acid is a proton donor

A Brønsted-Lowry base is a proton acceptor

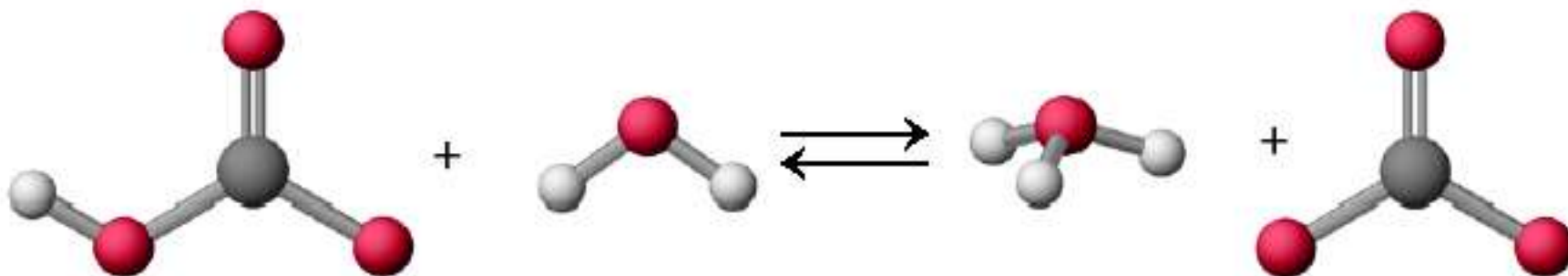
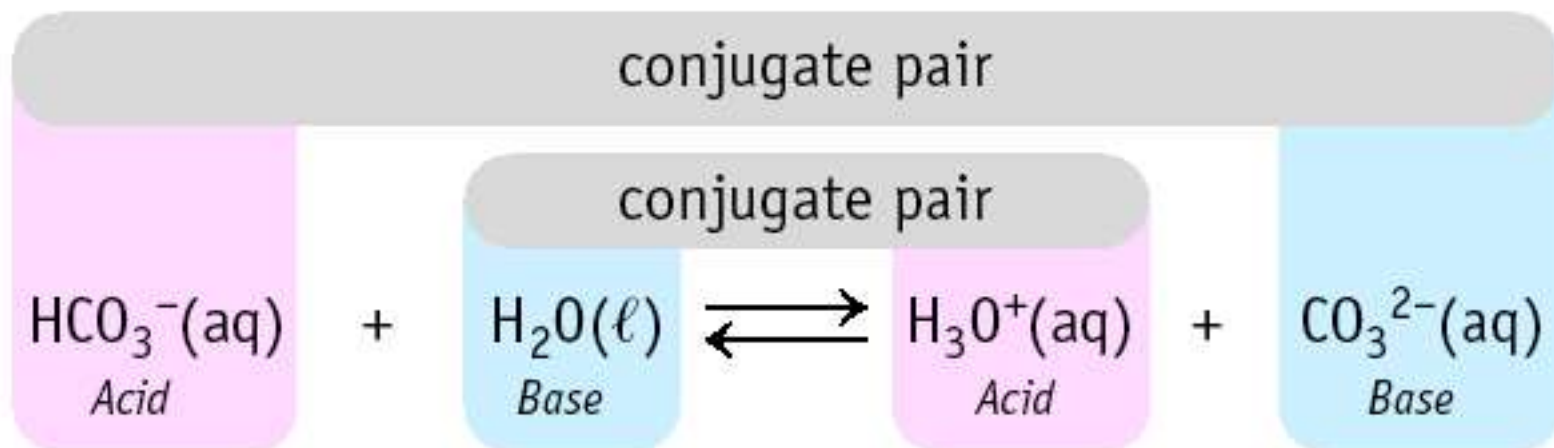




conjugate acid: substance formed when base gains a hydrogen ion

conjugate base: substance formed when an acid loses a hydrogen ion

Conjugate Pairs



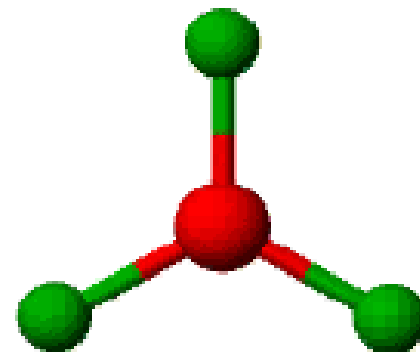
Suggested Practice Homework

Read 574-576, and #1-2

Acids & Base Definitions

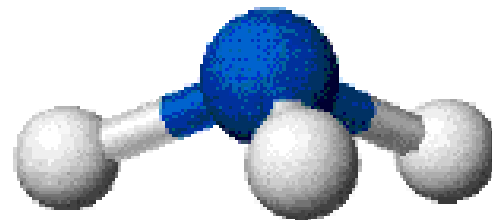
Definition #3: Lewis

Lewis acid - a substance that accepts an electron pair



BF_3 , the boron atom is surrounded by only three electron pairs.

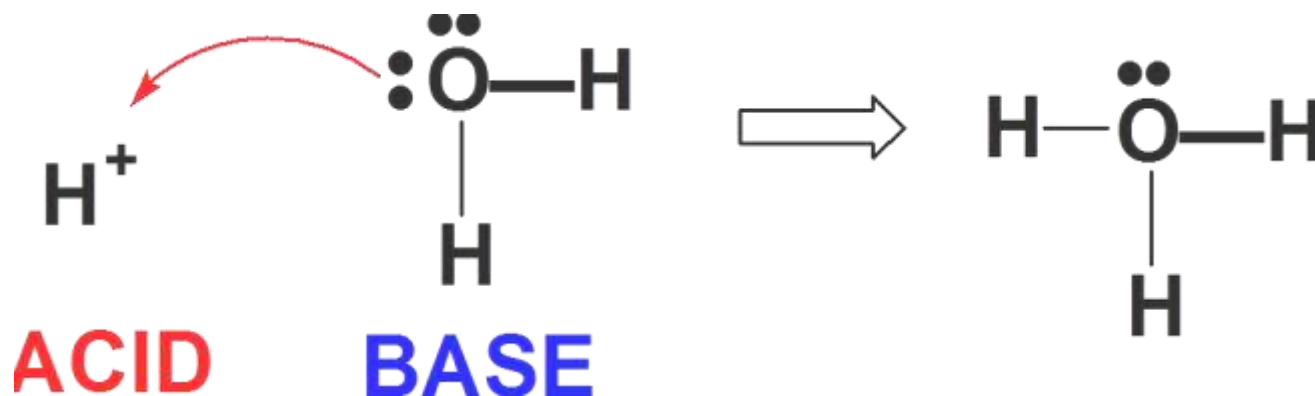
Lewis base - a substance that donates an electron pair



NH_3 , the N atom has three bond pairs and one lone pair of electrons.

Lewis Acids & Bases

Formation of hydronium ion is also an excellent example.



Electron pair of the new O-H bond originates on the Lewis base.

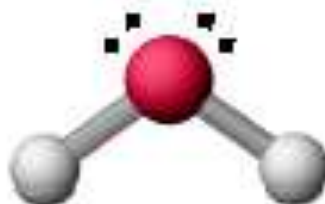
Lewis Acid/Base Reaction

Lewis Acid

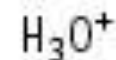
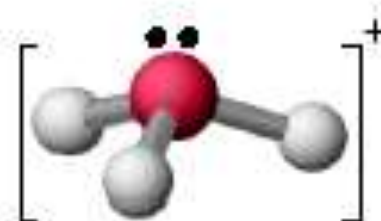


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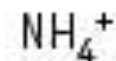
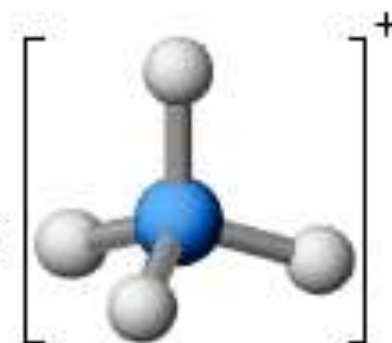
Lewis Base



Adduct



+



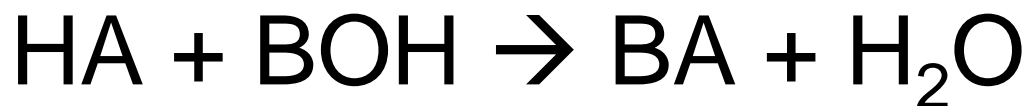
Learning Check!

Label the acid, base, conjugate acid, and conjugate base in each reaction:



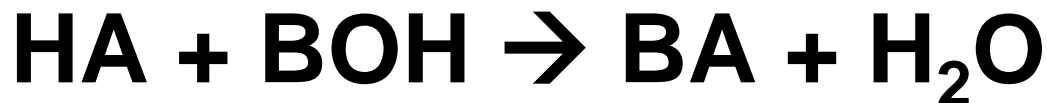
For most Acid Bases Rxns

The generic equation for most acid base rxn is:

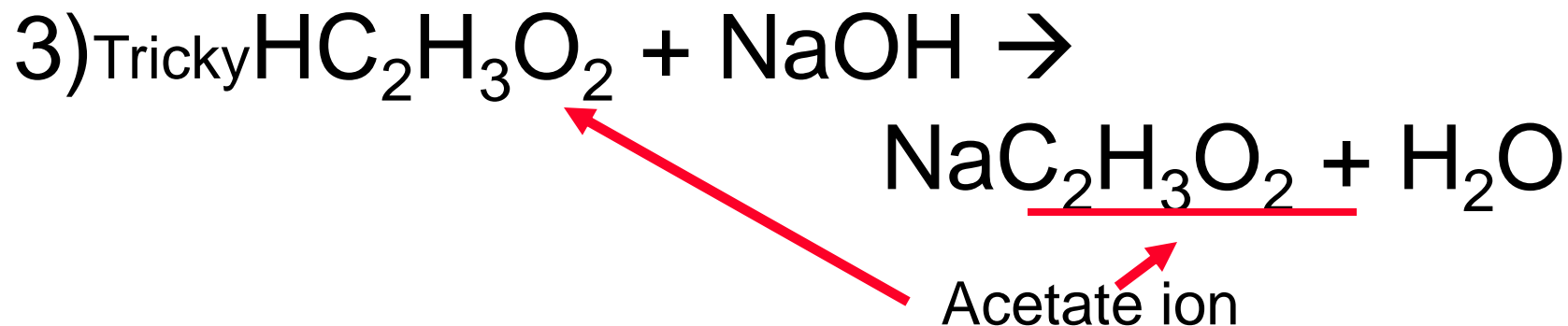
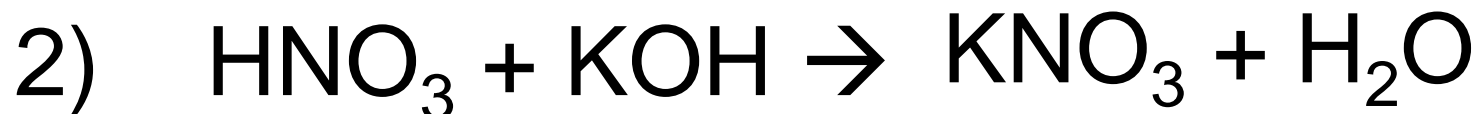
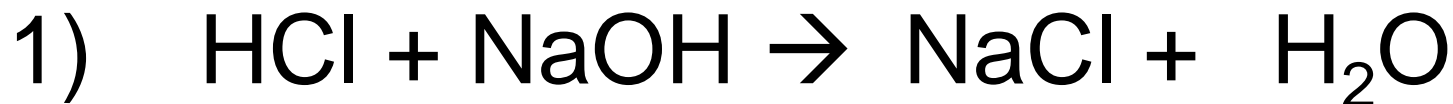


You will get a salt and water out of an acid base rxn!

You try... write out the products:

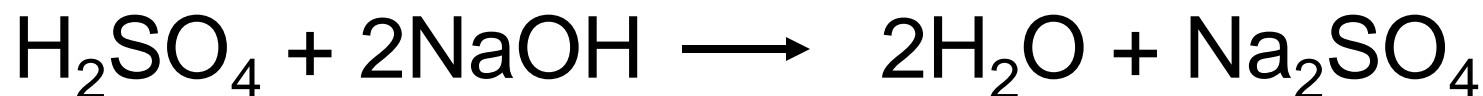


You will get a salt and water out of an acid base rxn!



What volume of a 1.420 M NaOH solution is required to titrate 25.00 mL of a 4.50 M H₂SO₄ solution?

WRITE THE BALANCED CHEMICAL EQUATION!



volume acid $\xrightarrow[\text{acid}]{M}$ moles acid $\xrightarrow[\text{Bridge}]{\text{Mole}}$ moles base $\xrightarrow[\text{base}]{M}$ volume base

$$25.00 \text{ mL} \times \frac{4.50 \text{ mol H}_2\text{SO}_4}{1000 \text{ mL soln}} \times \frac{2 \text{ mol NaOH}}{1 \text{ mol H}_2\text{SO}_4} \times \frac{1000 \text{ mL soln}}{1.420 \text{ mol NaOH}} = 158 \text{ mL}$$

Suggested Practice Homework

Read 580, and #9-12

Bell Work

26-April-16

What are the strong acids you must know?

What is the conjugate base in the reaction below?



What do bases taste like?

Agenda

Acid base definitions

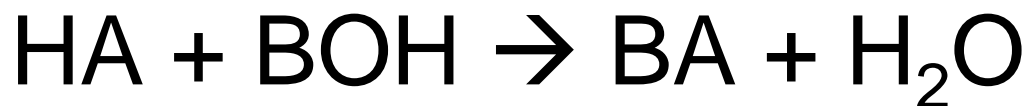
pH

Objective:

You will be able to describe the pH scale.

For most Acid Bases Rxns

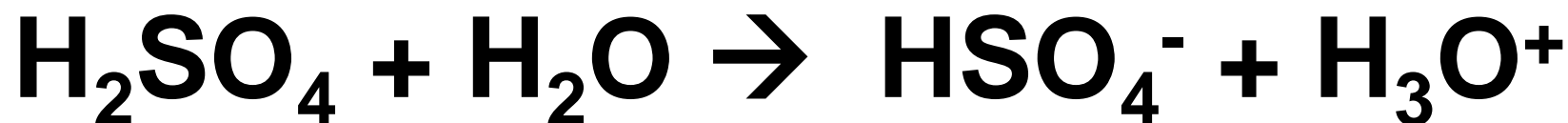
The generic equation for most acid base rxn is:



You will get a salt and water out of an acid base rxn!

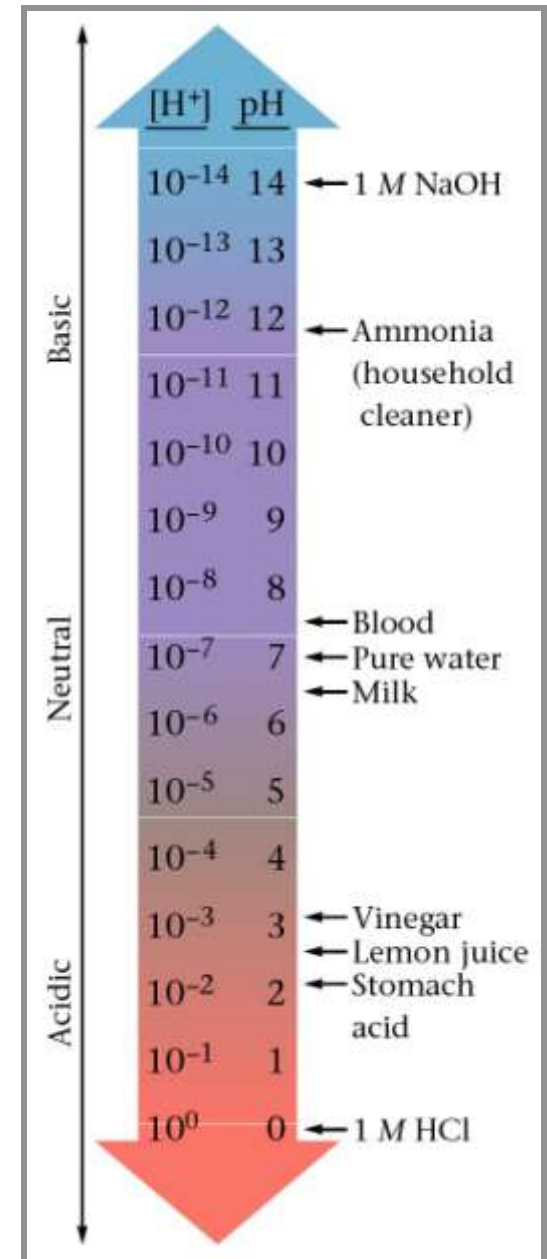
Recap!

Identify the acid, base, and conjugate acid and base in each equation:



pH scale = way of expressing the strength of acids & bases. Instead of using very small #'s, we just use the **NEGATIVE** power of 10 on the Molarity of the H^+ (or OH^-) ion.

Under 7 = acid
 7 = neutral
 Over 7 = base



pH of Common Substances



Figure 5.17 pH values of some common substances. Here the "bar" is colored red at one end and blue at the other. These are the colors of litmus paper, commonly used in the laboratory to decide if a solution is acidic (litmus is red) or basic (litmus is blue). (Charles D. Winters)

Bell Work
27-April-16

A- What is a Brønsted – Lowry base ?

B- what is the $[H^+]$ concentration of a solution with a pH of 8.1?

Agenda

Acid base definitions

pH

pH \rightarrow $[H^+]$

Objective:

You will start to look at calculating pH and $[H^+]$ and be able to describe the pH scale.

Calculating the pH

$$\text{pH} = -\log [\text{H}^+]$$

$$\text{pH} = -\log [\text{H}_3\text{O}^+]$$

(Remember that the [] mean Molarity)

Example: If $[\text{H}^+] = 1 \times 10^{-10}$

$$\text{pH} = -\log 1 \times 10^{-10}$$

$$\text{pH} = -(-10)$$

$$\text{pH} = 10$$

For a strong acid $[\text{H}^+] \sim$ the molarity of the solution

Calculating the pH

$$\text{pH} = -\log [\text{H}^+]$$

(Remember that the [] mean Molarity)

Example: If $[\text{H}^+] = 1.8 \times 10^{-5}$

$$\text{pH} = -\log 1.8 \times 10^{-5}$$

$$\text{pH} = -(-4.74)$$

$$\text{pH} = 4.74$$

Try These!

Find the pH of these:

- 1) A 0.15 M solution of Hydrochloric acid
- 2) A 3.00×10^{-7} M solution of Nitric acid
- 3) A 6.0M solution of Sulfuric acid

pH Cals. Solving for $[H^+]$

If the pH of Coke is 3.12, $[H^+] = ???$

Because $pH = -\log [H^+]$ then

$$-pH = \log [H^+]$$

Take antilog (10^x) of both sides and get

$$10^{-pH} = [H^+]$$

$$[H^+] = 10^{-3.12} = 7.6 \times 10^{-4} \text{ M}$$

*** to find antilog on your calculator, look for “Shift” or “2nd function” and then the “log” button



Homework

Finish pH Acid Base Practice up to Titrations

Practice

What is the pH of a solution with a proton concentration of 0.032 M?

What is the proton concentration in a solution with pH of 9.24?

pH Cals. Solving for H^+

A solution has a pH of 8.5. What is the Molarity of hydrogen ions in the solution?

$$pH = -\log [H^+]$$

$$8.5 = -\log [H^+]$$

$$-8.5 = \log [H^+]$$

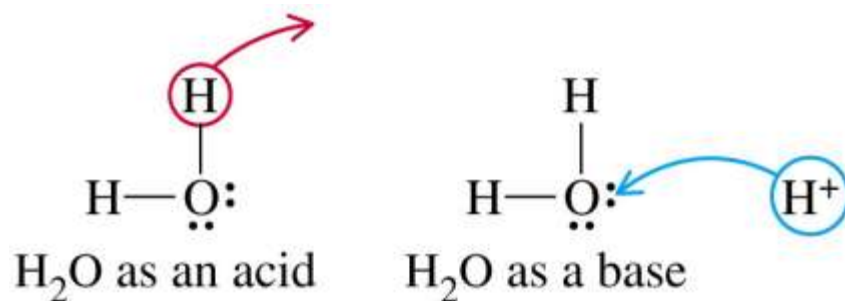
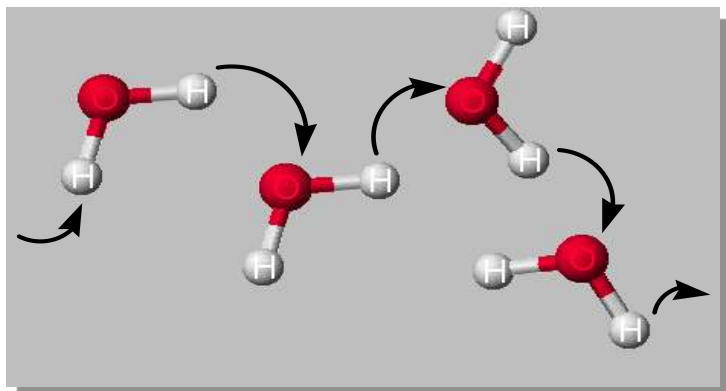
$$\text{Antilog } -8.5 = \text{antilog} \\ (\log [H^+])$$

$$10^{-8.5} = [H^+] \rightarrow \mathbf{3.16 \times 10^{-9} \text{ M}}$$

More about Water

H₂O can act as both an ACID & a BASE.

In pure water there can be
AUTOIONIZATION

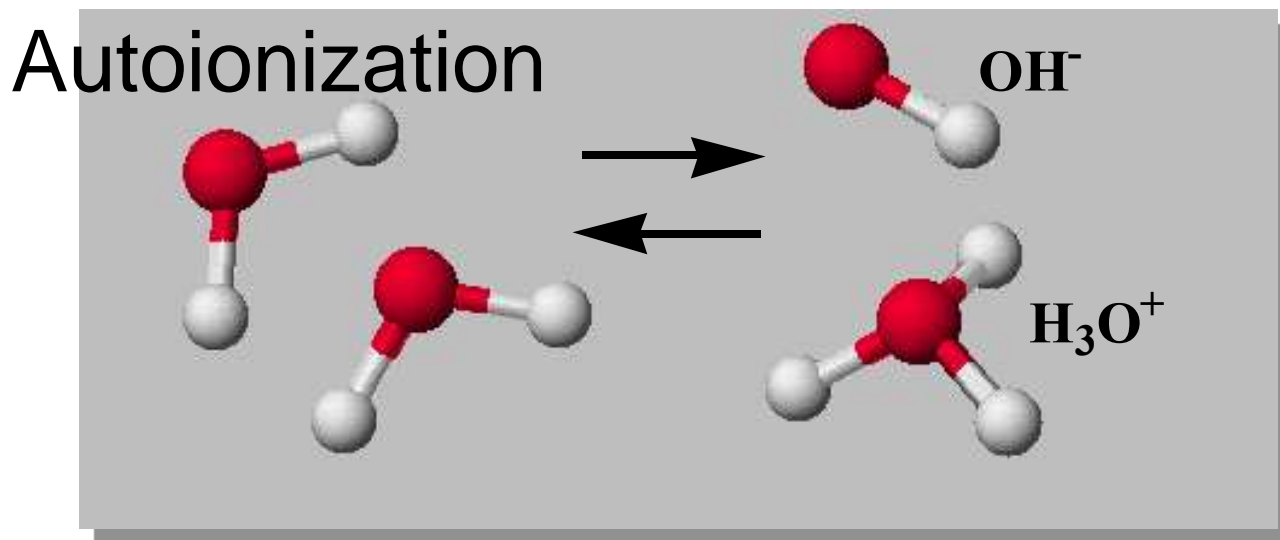


Equilibrium constant for water = K_w

$$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1.00 \times 10^{-14} \text{ at } 25^\circ\text{C}$$

$$K_w = [\text{H}^+][\text{OH}^-] =$$

More about Water



$$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 1.00 \times 10^{-14} \text{ at } 25^\circ\text{C}$$

In a neutral solution $[\text{H}_3\text{O}^+] = [\text{OH}^-]$

$$\text{so } K_w = [\text{H}_3\text{O}^+]^2 = [\text{OH}^-]^2$$

$$\text{and so } [\text{H}_3\text{O}^+] = [\text{OH}^-] = 1.00 \times 10^{-7} \text{ M}$$

pOH

Since acids & bases are opposites, pH and pOH are opposites!

pOH does not really exist, but it is useful for changing bases to pH.

$$\underline{pOH = -\log [OH^-]}$$

Since pH and pOH are on opposite ends of scale,

$$pH + pOH = 14$$

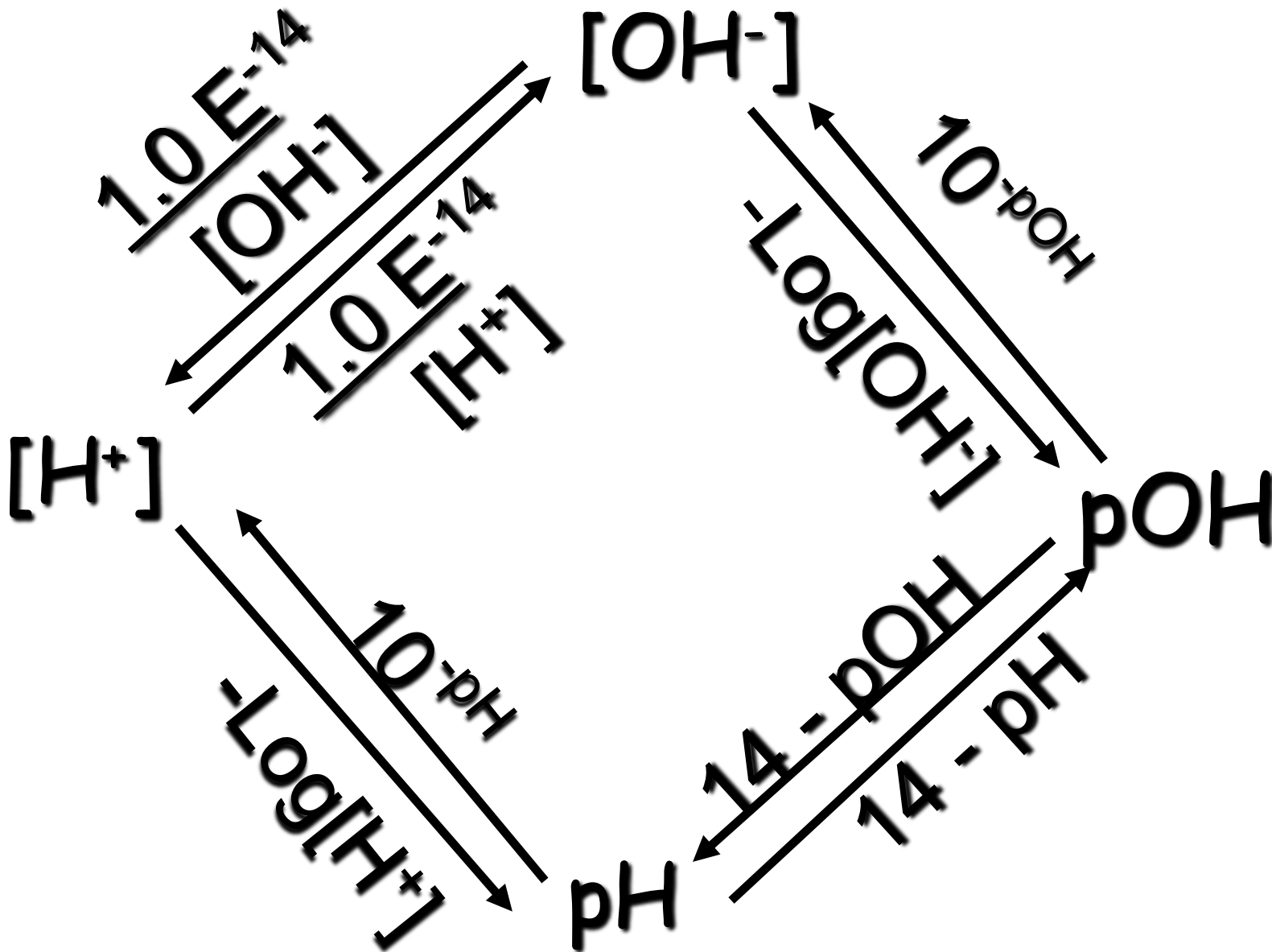
$$\mathcal{K}_w$$

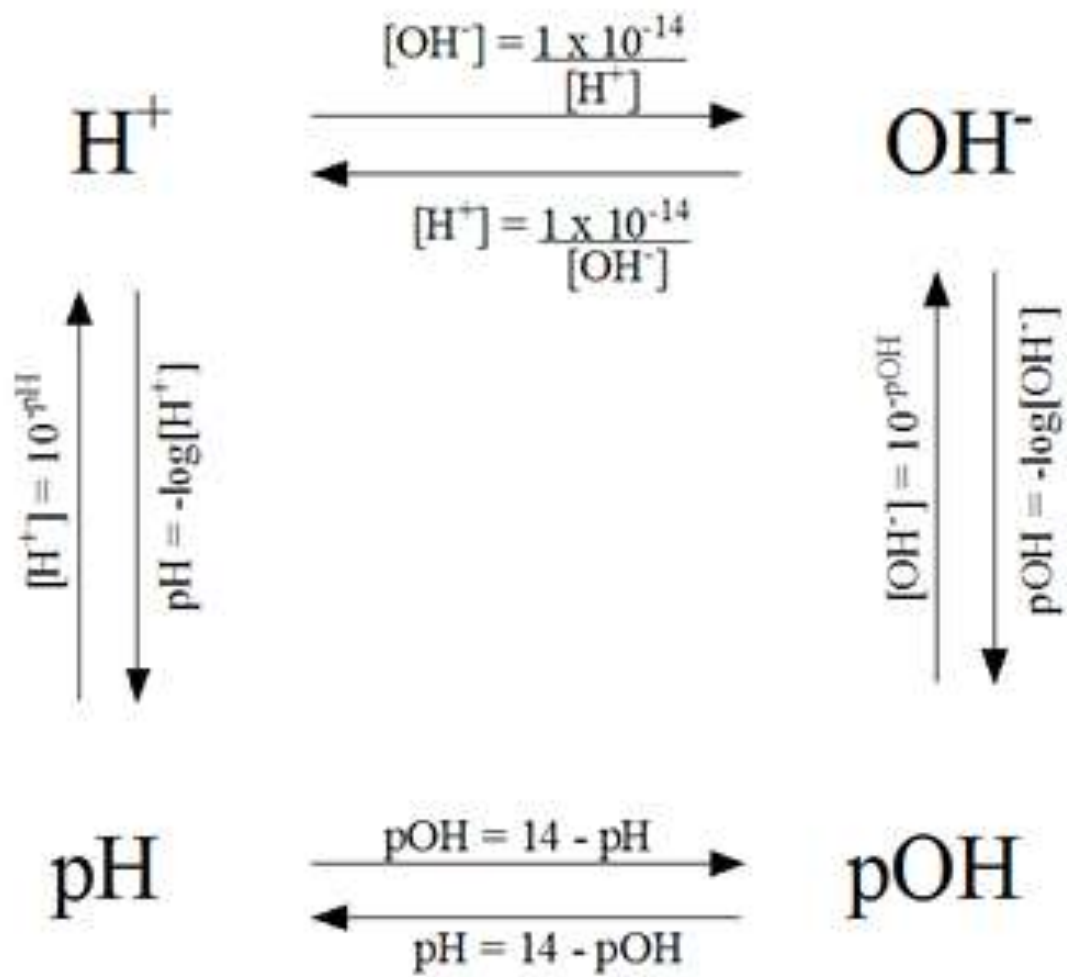
Water dissociation
constant; K_w .

$$K_w = 1.0 \times 10^{-14}$$

$$K_w = [\text{H}^+][\text{OH}^-]$$

$$1.0 \times 10^{-14} = [\text{H}^+][\text{OH}^-]$$





Bell Work 1.May.2017

A student dilutes concentrated hydrochloric acid to make two solutions:

(a) 3.0 M

(b) 0.0024 M.

Calculate the $[H^+]$, pH, $[OH^-]$, and pOH of the two solutions at 25°C.

EQ:

Why is pH so misunderstood?

Objective

Are you up to speed?

pH, $[H^+]$, etc. calculation Recap

Quick Quiz #2.8, p.3

1. On the pH scale bases would be what range?

>7

2. In the rxn below what is the acid?



3. List the three strong acids you must know?

HCl, HNO₃, H₂SO₄

4. If a solution is made by dissolving 2.5g of KOH (MM 56.0 g/mol) to a volume of 1.0L, what is the pH?

12.65

5. A 0.220 M solution of an acid has a pH of 4.26. What is the [H⁺]? **5.49E⁻⁵**

pH testing

There are several ways to test pH

- Blue litmus paper (red = acid)
- Red litmus paper (blue = basic)
- pH paper (multi-colored)
- pH meter (7 is neutral, <7 acid, >7 base)
- Universal indicator (multi-colored)
- Indicators like phenolphthalein
- Natural indicators like red cabbage, radishes

Red litmus paper with a drop of base here



Blue litmus paper with a drop of acid here



Paper testing

Paper tests like litmus paper and pH paper





- Place a drop of the solution from the end of the stirring rod onto a piece of the paper
- Read and record the color change. Note what the color indicates.
- You should only use a small portion of the paper. You can use one piece of paper for several tests.



pH paper

Behavior of Salts in Water

Table 18.8 The Behavior of Salts in Water

Salt Solution (Examples)	pH	Nature of Ions	Ion That Reacts with Water	
Neutral [NaCl, KBr, Ba(NO ₃) ₂]	7.0	Cation of strong base Anion of strong acid	None	
Acidic [NH ₄ Cl, NH ₄ NO ₃ , CH ₃ NH ₃ Br]	<7.0	Cation of weak base Anion of strong acid	Cation	
Acidic [Al(NO ₃) ₃ , CrCl ₃ , FeBr ₃]	<7.0	Small, highly charged cation Anion of strong acid	Cation	
Basic [CH ₃ COONa, KF, Na ₂ CO ₃]	>7.0	Cation of strong base Anion of weak acid	Anion	

pH meter

Tests the voltage of the electrolyte

Converts the voltage to pH

Very cheap, accurate

Must be calibrated with a buffer solution



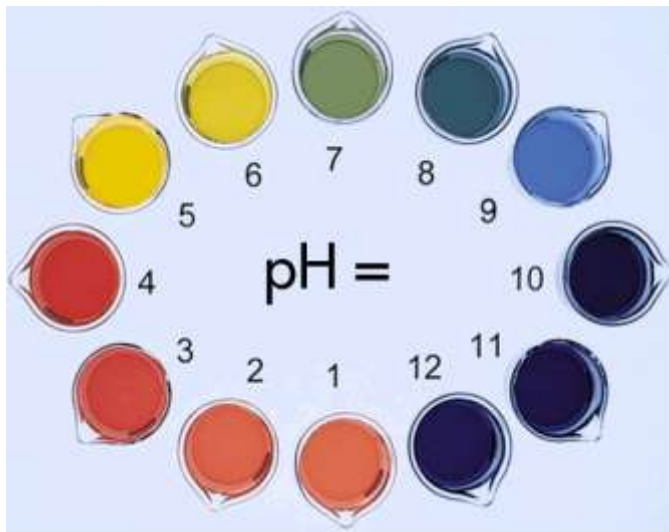
pH indicators

Indicators are dyes that can be added that will change color in the presence of an acid or base.

Some indicators only work in a specific range of pH

Once the drops are added, the sample is ruined

Some dyes are natural, like radish skin or red cabbage



Bell Work 2May2017

Write the balance equation for sodium hydroxide reacting with hydrochloric acid.

If **10.0mL** of sodium hydroxide is reacted (neutralized) with **25.0mL** of **0.05M** hydrochloric acid, what is the concentration of the sodium hydroxide?

EQ:

Why is pH so misunderstood?

Objective

**You will be able to set up a burette and
dispense specific quantities of analyte to a
reaction flask**

Titration; Setting up Burette ⁷⁴

1. Attach to ring stand using burette clamp
2. Open burette and rinse with DI water into a waste beaker.
3. Close burette after all DI water and drained through run 2-5mL of through burette to coat sides.
4. Close burette and load titrant, run just enough titrant through burette to remove all air bubbles from spout.

**Titrant; what you know
(known concentrations)**

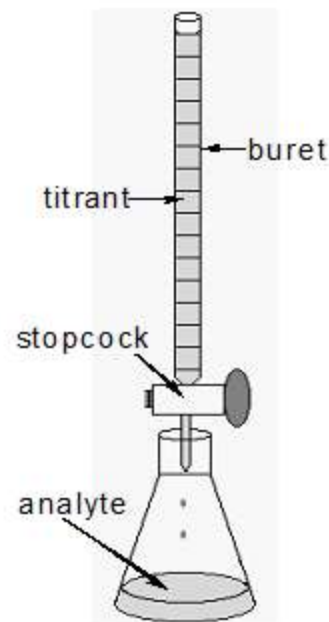


Figure 1: Titration Setup

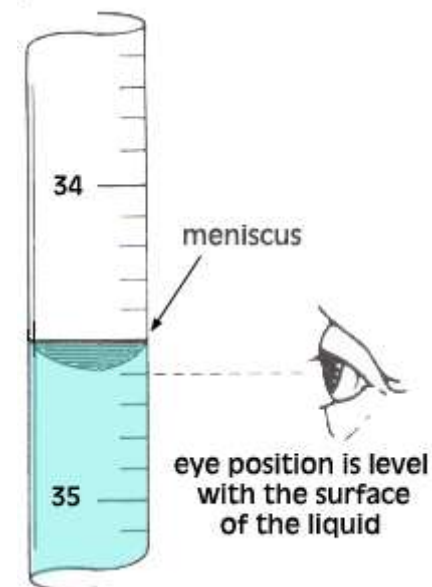
**Analyte; what you
are trying to find**

*Titration, Reading a Burette:*⁷⁵

Make sure burette is level.

5. Record initial volume by reading bottom of meniscus

6. After titration is complete, read final volume and record.



	Trial 1	Trail 2
Vol _{initial}		
Vol _{Final}		
Vol _{dispensed}		

Titration

- I. Practice rinsing burette and setting up for use.
- II. Load burette with titrant (just water today)
- III. Add known amount of analyte to a Erlenmeyer Flask (just water today)
- IV. Each person: Practice dispensing titrant in amounts of 10ml, 5mL, 2mL, 1mL, and 0.1mL.
- V. Clean up, always leave burette in the open position and make sure you have rinsed 2-3x with DI water!***

Acid Base Titration Calculations

Recall our dilution formula

$$M_1 V_1 = M_2 V_2$$

M = Molarity (mol/L)

V = Volume (L)

Think of it like this:

$$M_{\text{acid}} V_{\text{acid}} = M_{\text{base}} V_{\text{base}}$$

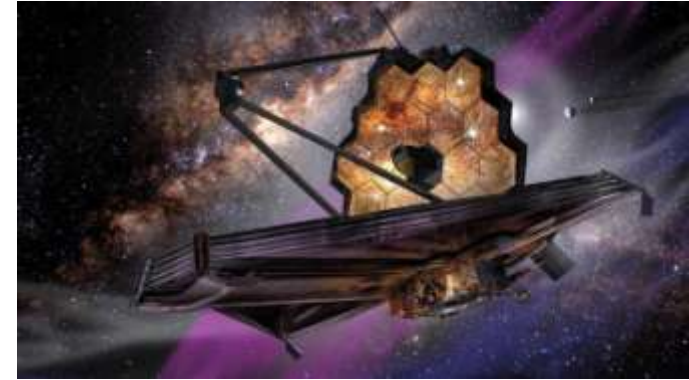
Final FWUSD STEM Lecture,

Who: Dr. Everett Schlawin

What: The James Webb Space Telescope and the Closest Yet Looks at New Worlds

When: Tuesday, May 2nd from 3:45pm-5:00pm

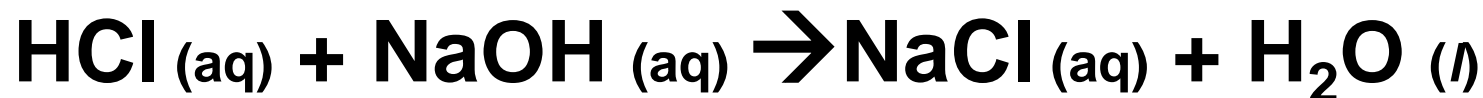
Where: Flowing Wells Board Room (note location change)



Talk Summary: The James Webb Space Telescope (JWST) is coming to a Lagrangian point near you! Set to launch in October 2018, JWST will be the largest ever space telescope. It will explore the darkest and deepest parts of the Universe as well as inspect exoplanets to levels that have never been achieved before. I will discuss the status of the telescope, the University of Arizona-led infrared camera called NIRCam and how JWST will explore new planets.

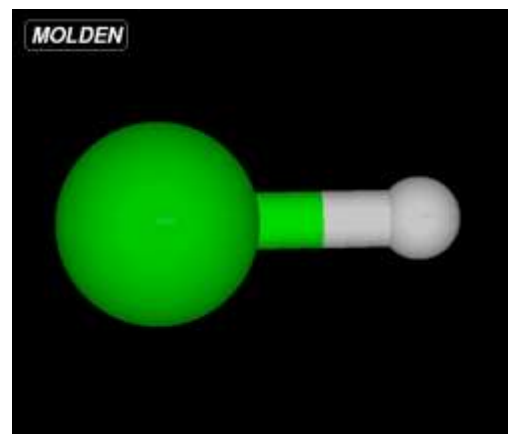
Extra Credit (5points) if you type up a 0.5-1.0page summary of the lecture including what you learned and how it applies to your life.
Due to Mr. Golden by 4May2017

Acid Base Rxn Titration



acid base

**Carry out this reaction using a
TITRATION.**



Practice

When ammonia reacts with water an ammonium ion and hydroxide is produced.

-Write a balanced equations.

-What type of base is ammonia if it is producing hydroxide?

Bell Work; 3-May-2017

**Please complete the “Intro to Titration Lab”,
data table on lower $\frac{1}{4}$ of a blank sheet of paper.**

	Trial 1	Trial 2	Trial 3	Trial 4
Molarity of NaOH				
Initial Burret reading (ml)				
Final Buret reading (ml)				
Amount of NaOH despined (ml)				
Vol. of Unknown acid used (ml)				
Molarity of unknown acid				

EQ:

Why is pH so misunderstood?

Objective

You will complete an acid base neutralization titration to end point in order to determine [HCl] solution.

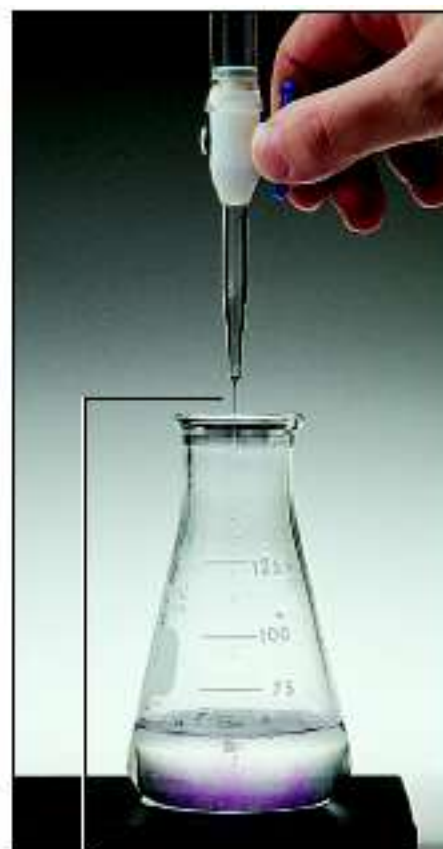
Intro To titration Lab, “what is actually happening!”

- 1. Why does the “pink” appear?**
- 2. Why does the rate of “pink” disappearance decrease as you approach the end point?**

Setup for titrating an acid w/ a base



(a)
50-mL buret containing aqueous NaOH of accurately known concentration



(b)
A solution of NaOH is added slowly to the sample being analyzed. The sample is mixed.



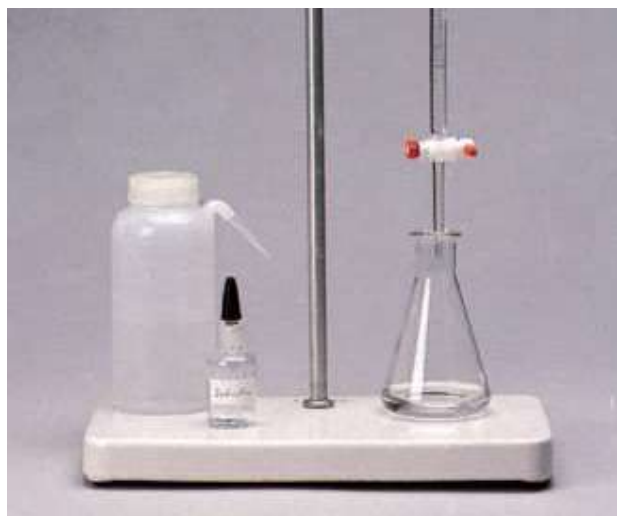
(c)
When the amount of NaOH added from the buret exactly equals the amount of H^+ supplied by the acid being analyzed, the dye (indicator) changes color.

Titration

In a *titration* a solution of accurately known concentration is added gradually to another solution of unknown concentration until the chemical reaction between the two solutions is complete.

Equivalence point the point at which the reaction is complete

Indicator – substance that changes color at (or near) the equivalence point



Slowly add base
to unknown acid
UNTIL
the indicator
changes color



Intro to Titrations

1. Add solution from the buret (base).
 2. Reagent (base) reacts with compound (acid) in solution in the flask.
 3. Indicator shows when exact stoichiometric reaction has occurred. $[\text{Acid}] = [\text{Base}]$
- This is called NEUTRALIZATION.



Bell Work 4-May-2017

A. What is a salt? (You best not say NaCl)

B. What is the concentration of HBr in an Erlenmeyer flask if it took 23.1mL of 0.05M to neutralize 15.0mL of it ?

Use stiochiometry and $M_a V_a = M_b V_b$

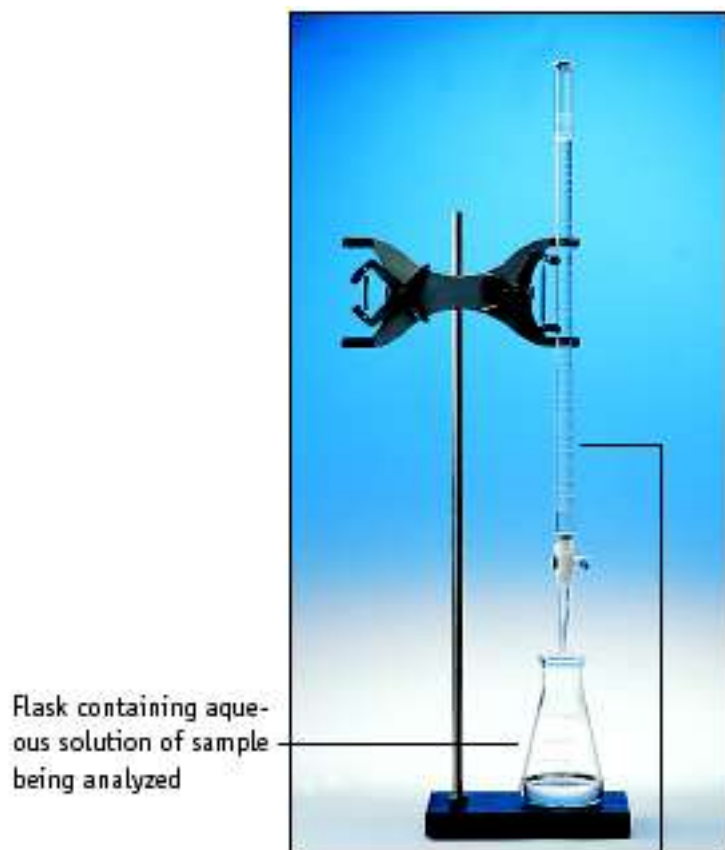
(Hint HBr : NaOH is 1H⁺: 1OH⁻)

EQ: Why is pH so misunderstood?

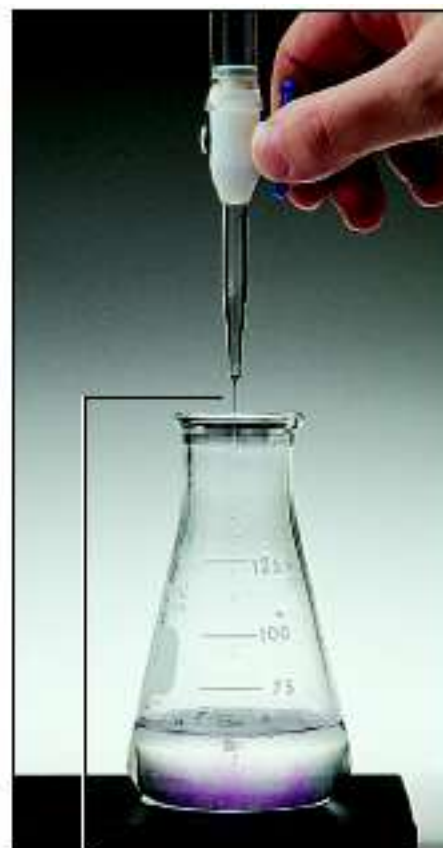
Objective

You will finish the Intro to titration complete an acid base neutralization titration to end point in order to determine [HCl] solution.

Setup for titrating an acid w/ a base



(a)
50-mL buret containing aqueous NaOH of accurately known concentration



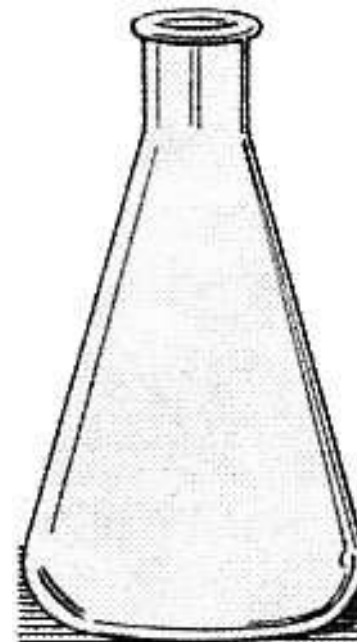
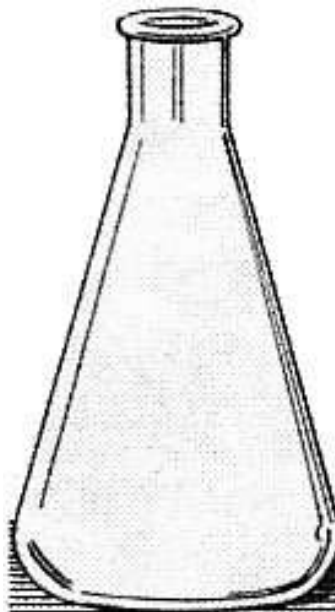
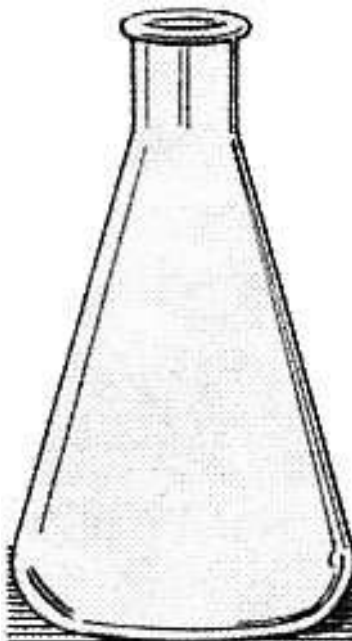
(b)
A solution of NaOH is added slowly to the sample being analyzed. The sample is mixed.



(c)
When the amount of NaOH added from the buret exactly equals the amount of H^+ supplied by the acid being analyzed, the dye (indicator) changes color.

What is happening in the Intro to titration Lab (Neutralization of HCl by NaOH)...

Draw three (3) Erlenmeyer Flasks. Under each condition record relative ratio of H^+ and OH^- .



Inside of the 1st
write out the
contents before the
titrations.

The 2nd : Rxn taking
place during the
titration (*before end
point*)

The 3rd : Content
of flask at end
points

Lab example: Neutralization of NaOH by HCl

35.62 mL of NaOH is neutralized with 25.2 mL of 0.0998 M HCl by titration to an equivalence point. What is the concentration of the NaOH?

Problem

What volume of 0.1 M HNO_3 is needed to completely neutralize 0.050 L of 0.2 M NaOH ?

What are we looking for?

What do we know

Acid Base Titration

Bell Work 5-May-2017

A. What is the major difference between a strong acid and a weak acid?

B. What is the concentration of NaOH in a burette if it took 18.1mL to neutralize 0.620g of K.H.P. (M.M. 204g/mol, $\text{C}_8\text{H}_5\text{KO}_4$) ?

(Hint KHP : NaOH is 1H^+ : 1OH^-)

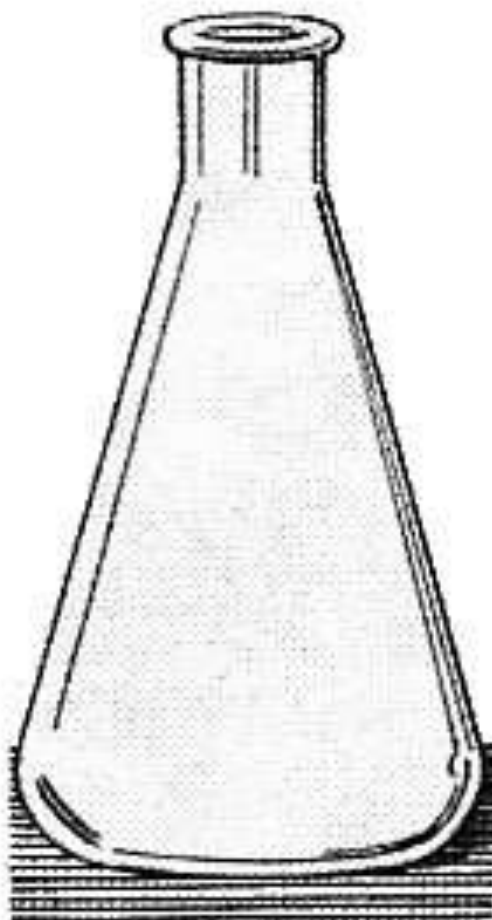
Agenda

Weak Acids Continued

Standardization of NaOH and pH Apple Juice Lab

Objective:

You will know how to find the H^+ of a weak acid give the equilibrium constant and be able to explain what a standardization titration is.



Standardization of NaOH Solution by Colorimetric Titration

Corrections

Page 2

“8: How much KHP would react completely with 15mL of ~~0.1M~~ **0.05M** NaOH?”

“Materials: ~~0.1M~~ **0.05M** sodium hydroxide (NaOH)”

Page 3

“5. Add ~ 50mL of ~~~0.1M~~ **~0.05M** NaOH to your buret”

Part II 1. Refill your buret to between the 0 and 5mL mark with the ~~~0.1M~~ **~0.05M** NaOH

Bell Work 8-May-2017

- I. What is the concentration of NaOH in a burette if it took 21.4mL to neutralize 0.500g of K.H.P. (M.M. 204g/mol, $\text{C}_8\text{H}_5\text{KO}_4$) during standadization?**
- II. Based on the pH of the NaOH you just standardized with K.H.P., what is the $[\text{H}^+]$ in a 5.0 mL sample of OJ if it took 12.2mL of NaOH to reach end point?**

EQ:

When does helping other not really help them

Agenda

Standardization of NaOH and pH Apple Juice Lab, Part II

Objective:

You will be able to explain what a standardization titration is at the atomic/ reaction level.

Standardization Titration Lab

Two part lab:

Part I: Titration 1 find molarity of NaOH

We will use a salt, KHP ($\text{KHC}_8\text{H}_4\text{O}_4$) to find the exact molarity of NaOH.

Once we know the molarity of the NaOH, we will...

Part II: Find molarity of unknown

Apple Juice,

**Again perform titrations to find the
exact molarity of your unknown**

Apple Juice

Standardization Titration Lab

Two part lab:

Part I: Titration 1 find molarity of NaOH

How many grams of KHP are you going to use?

What glassware will you use to make your KHP solution?

Standardization of NaOH and pH of Apple Juice

